

“Risk as a Resource”

“Meeting the Program Management Challenge”

Goddard Space Flight Center

March 30, 2004

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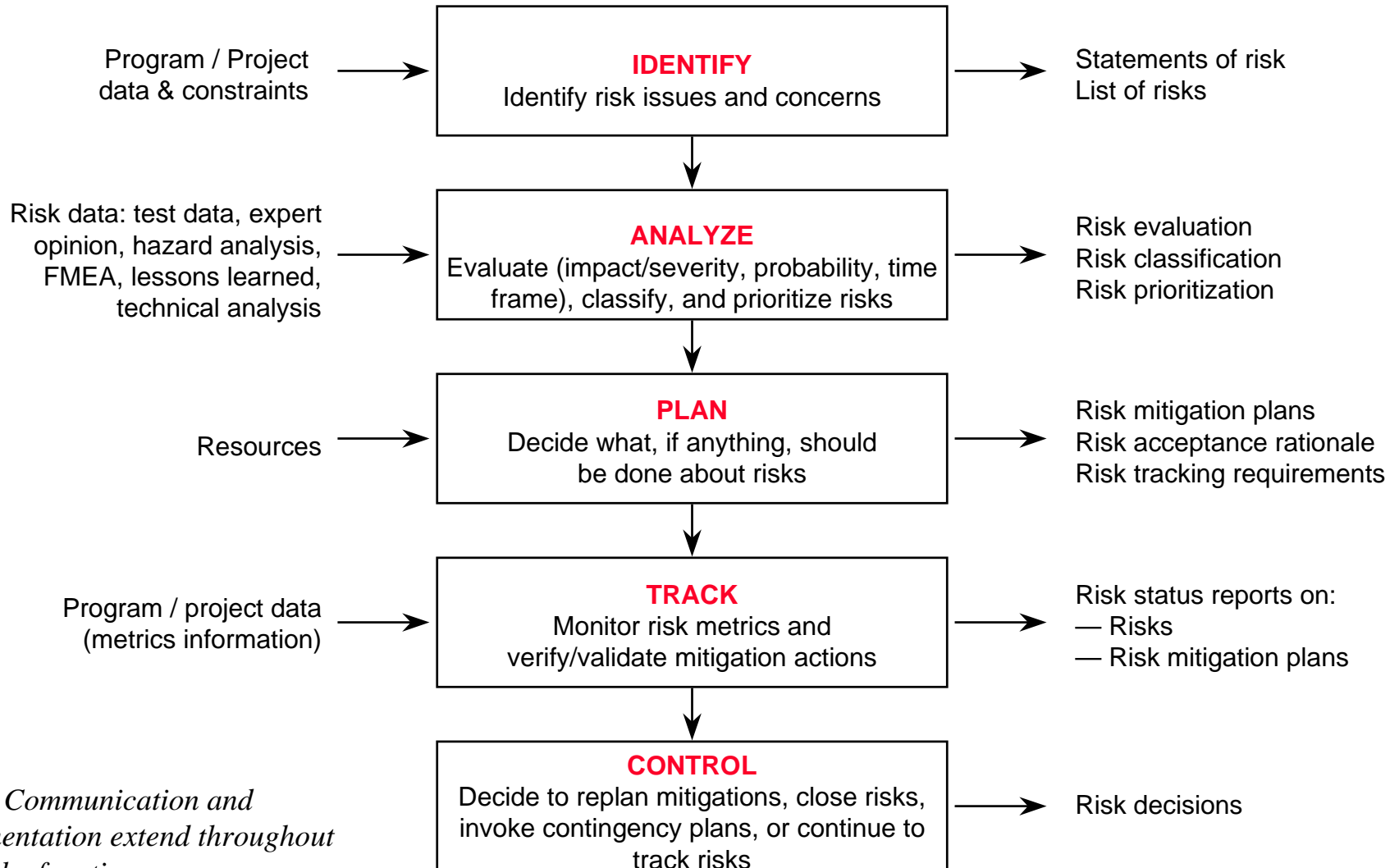
Topics



- How Much Risk Mitigation is Necessary?
- Risk Strategies Differences
 - Unknown Risk
 - Managed Risk
 - Risk Avoidance
- Risk Iceberg
- “Risk as a Resource”
- Product Assurance Role
- Summary



Risk Management Process



Note: Communication and documentation extend throughout all of the functions.

Risk Strategies

Unknown Risk

Generally unacceptable for Government-funded projects due to fiduciary responsibilities associated with the use of public funds.

(Not acceptable for safety risks.)

May be appropriate when the consequence of the risk is acceptable.

Managed Risk

“Risk as a Resource”

Risk to mission success is optimized with consideration of numerous variables including criticality of the mission to the agency strategic plan, cost, schedule criticality, mission duration, performance, etc.

Higher Risk	Medium Risk	Lower Risk
Lower confidence in mission success	Moderate confidence in mission success	Higher confidence in mission success

Baseline set of SMA activities necessary to identify, understand, and characterize risks.

(SMA life-cycle activities.)



Class D

Class C

B

A

Safety Of People

“Risk Avoidance”

Minimized Risk

Risk to people is generally reduced to the lowest level reasonably achievable.

(ALARA)

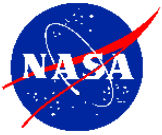
Must be reduced to level below *De Manifestis* risk and is desirable to reduce to *De Minimus* threshold.



Unknown Risk

Unknown Risk Approach May Be Acceptable

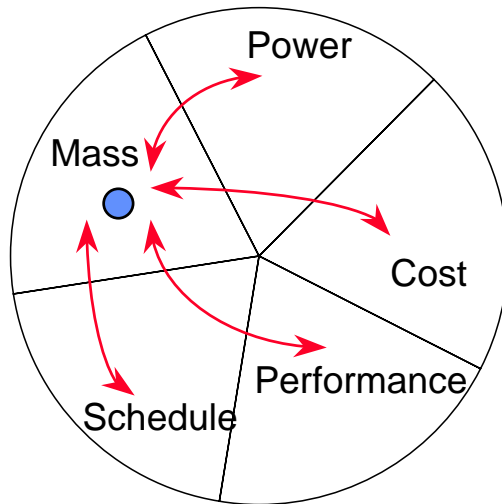
- Not acceptable for people safety risk
- Very low cost projects (inexpensive sounding rockets and balloon payloads)
- Initial phases of technology development and demonstration
- Missions where risk can be efficiently mitigated later through recovery and reflight like instruments on SOFIA or some balloon projects



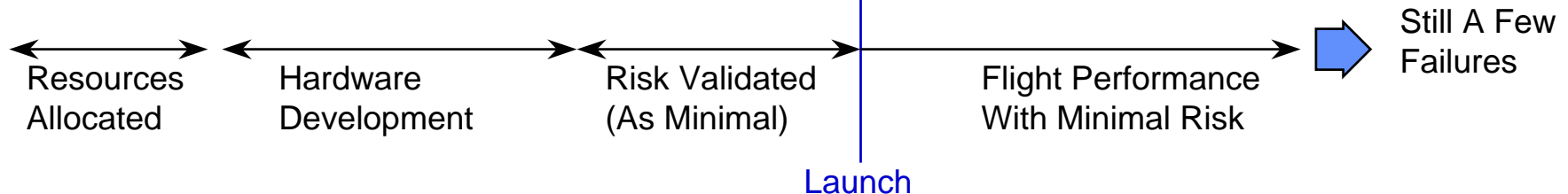
Risk Avoidance (Safety of People)

- Risk to Be Minimized (Avoided). Rule-based Approach
- Extensive Test and Analysis. Non-Compliance Formal Process
- Quantified Risks When Possible
- Residual Risk Is A Consequence of Deficiency in Tradable Resources or Lack of Knowledge

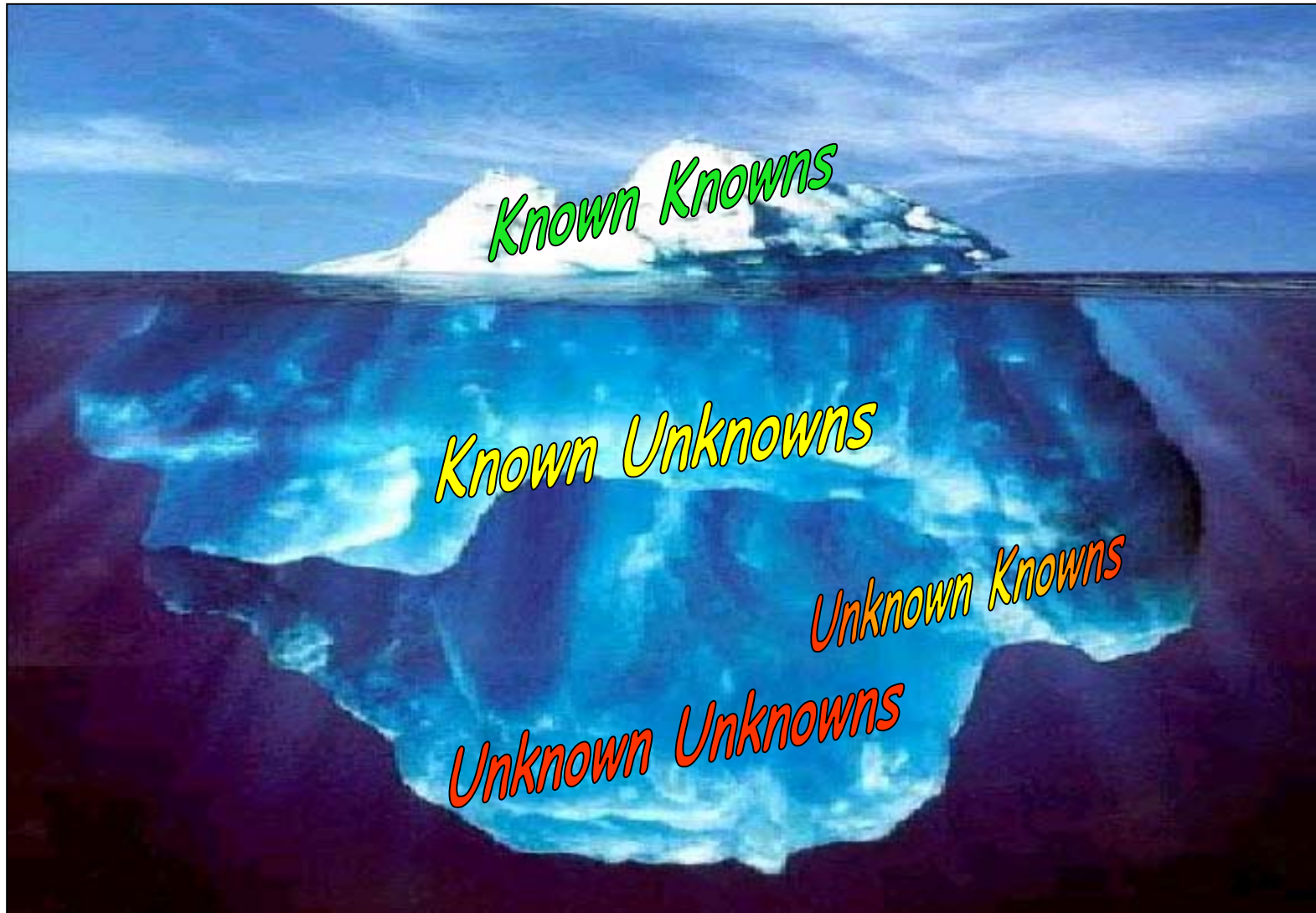
Tradable Resources



Large Projects
Human Space Flight
Schedule Slips
Cost Overruns



Lack of Knowledge - The Risk Iceberg





The Four Levels of the Risk Iceberg

- Known Knowns
 - Flight Data
 - Test as you fly
 - Demonstrated performance
 - Flight or test-validated analysis, simulations and models, Operation within certification limits
- Mitigation: sound program, engineering and operational management
- Known Unknowns
 - Generic but undemonstrated failure modes and hazards,
 - Risk analysis uncertainties
 - Acknowledged test and analysis limitations
 - Unverified modeling and simulation based predictions
 - Envelope expansion and operations within certification but out of family
- Mitigation: conservative flight rules, technical standards and safety factors



The Four Levels of the Risk Iceberg

→ Unknown Knowns

- Mis-communicated test or analysis results
- Uneven understanding of data or environment
- Poor documentation combined with loss of corporate memory

→ Mitigation: clear organizational structure, good communications, trending

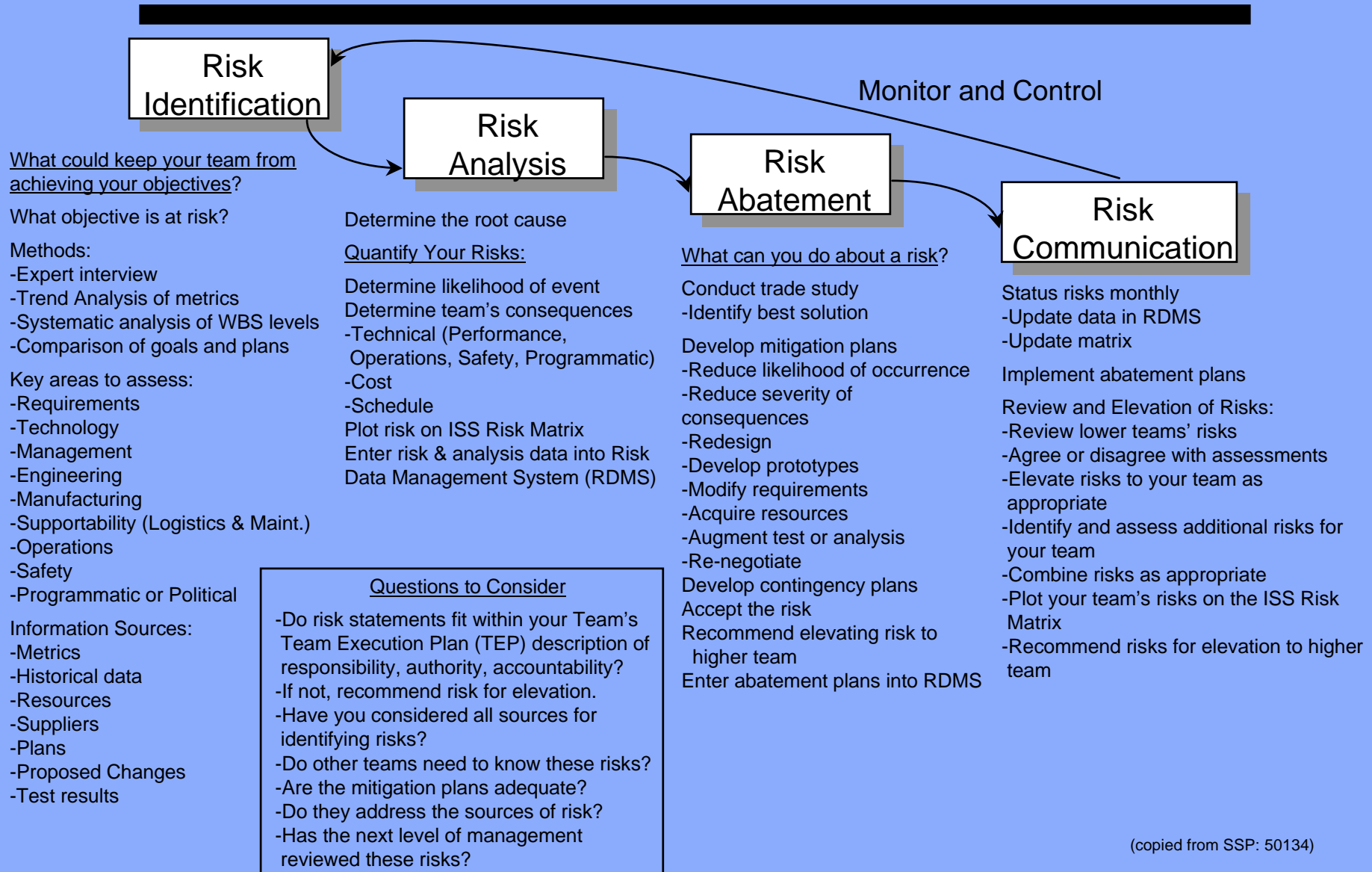
→ Unknown Unknowns

- Bad assumptions
- Untested new environments
- Unfinished experimental research
- Inadvertent operation outside of certification limits (temperature, Q, tire speed, etc.)

→ Mitigation: research and testing, rarely done by operational programs

Risk Avoidance Approach

ISS Program Risk Management

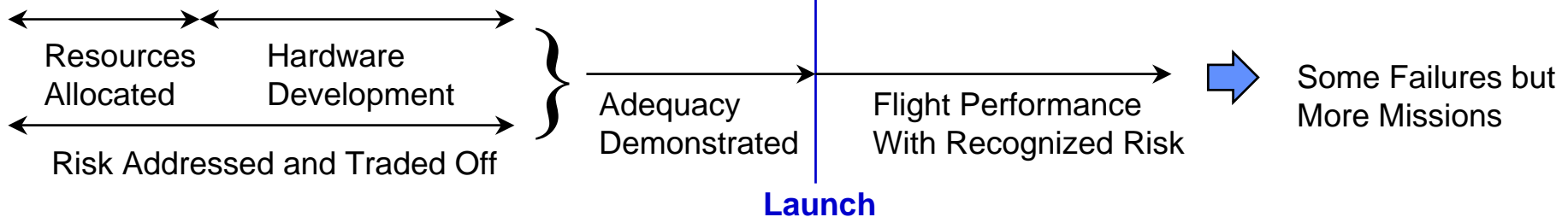
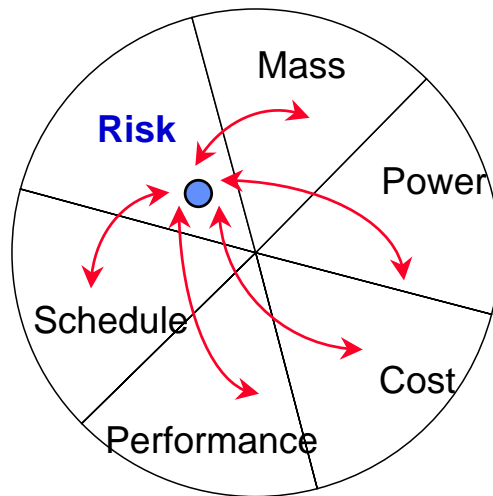




Managed Risk – “Risk as a Resource”

→ Risk to Be Identified and Thoughtfully Traded as a Resource with an Appropriate Level of Mitigation

Tradable Resources

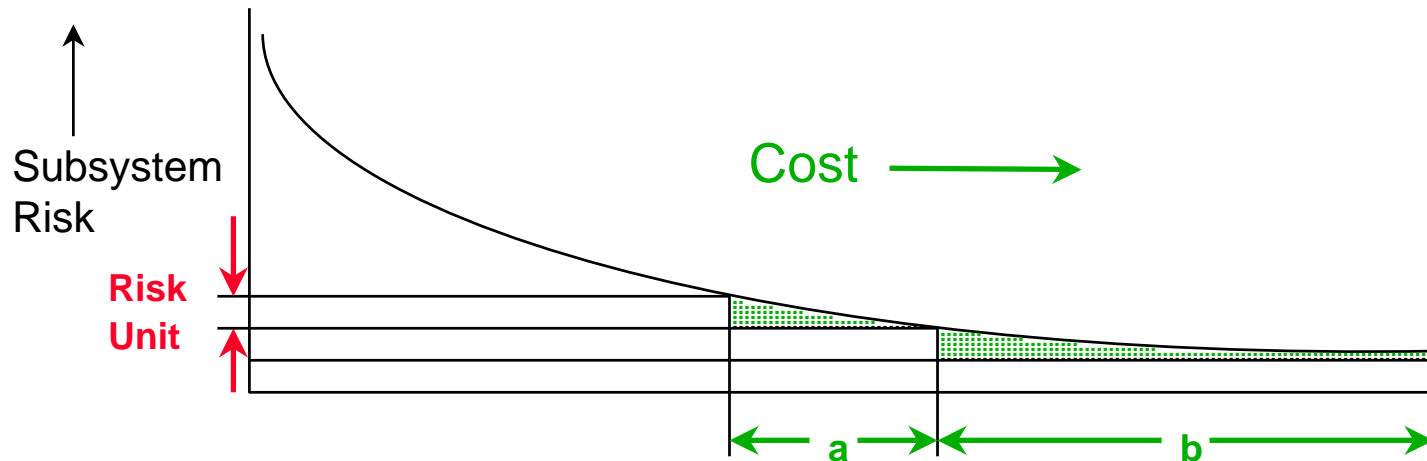




Reducing the Cost of Risk

Marginal Cost of Risk

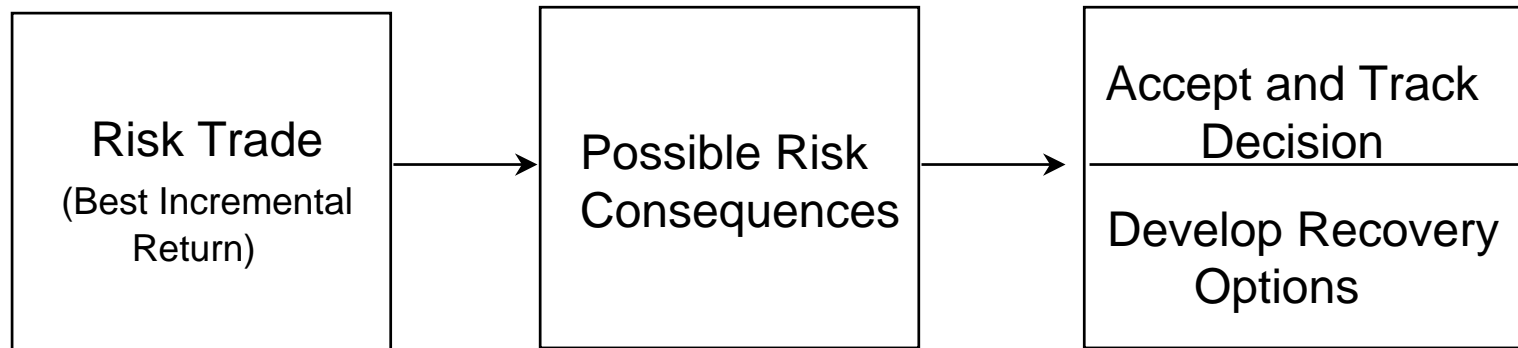
→ When the Cost Per “Unit of Risk Reduction” in a Given Component or Subsystem Increases Significantly -- STOP. Buy Down Risk Somewhere Else.



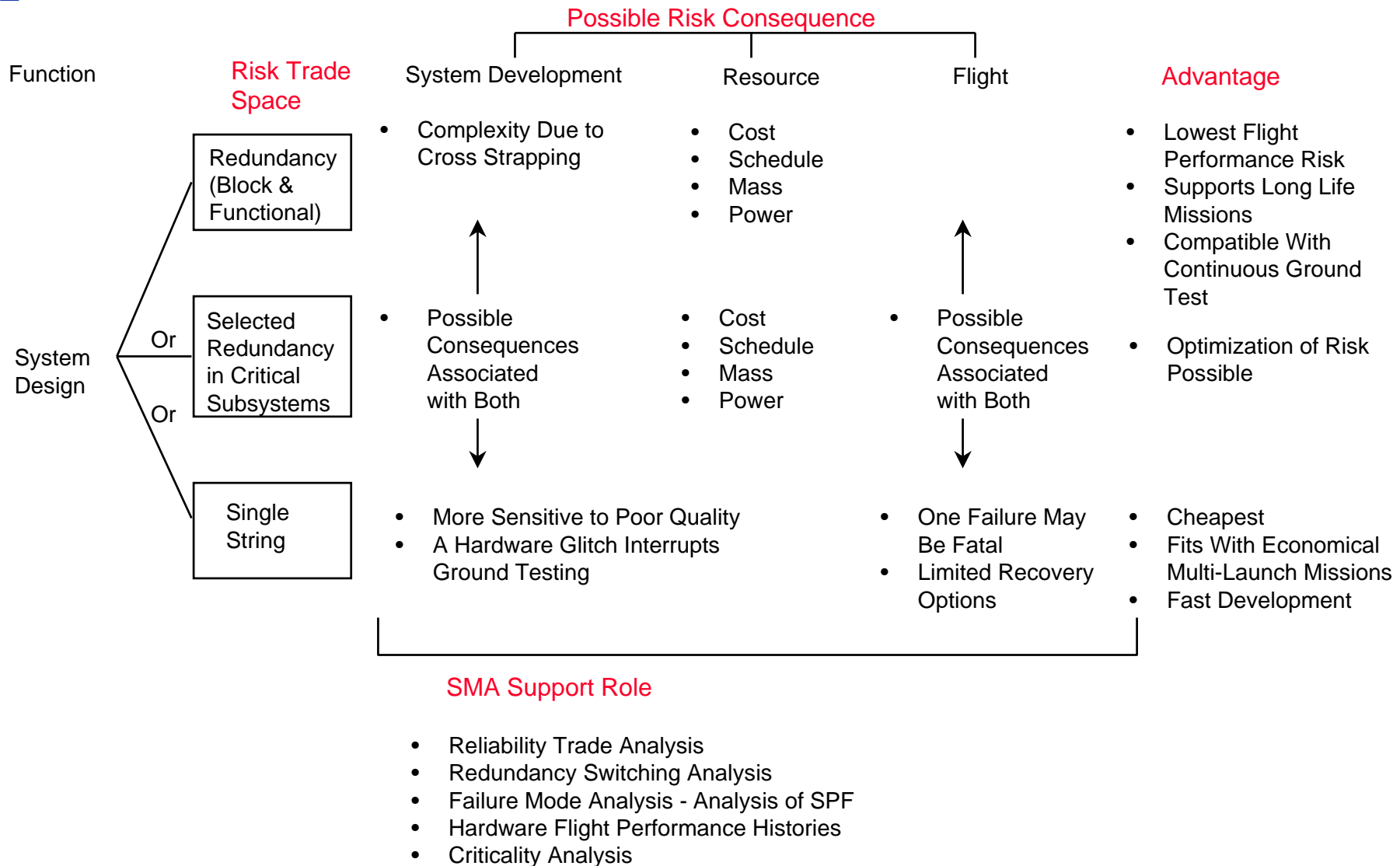


Risk as a Resource Process

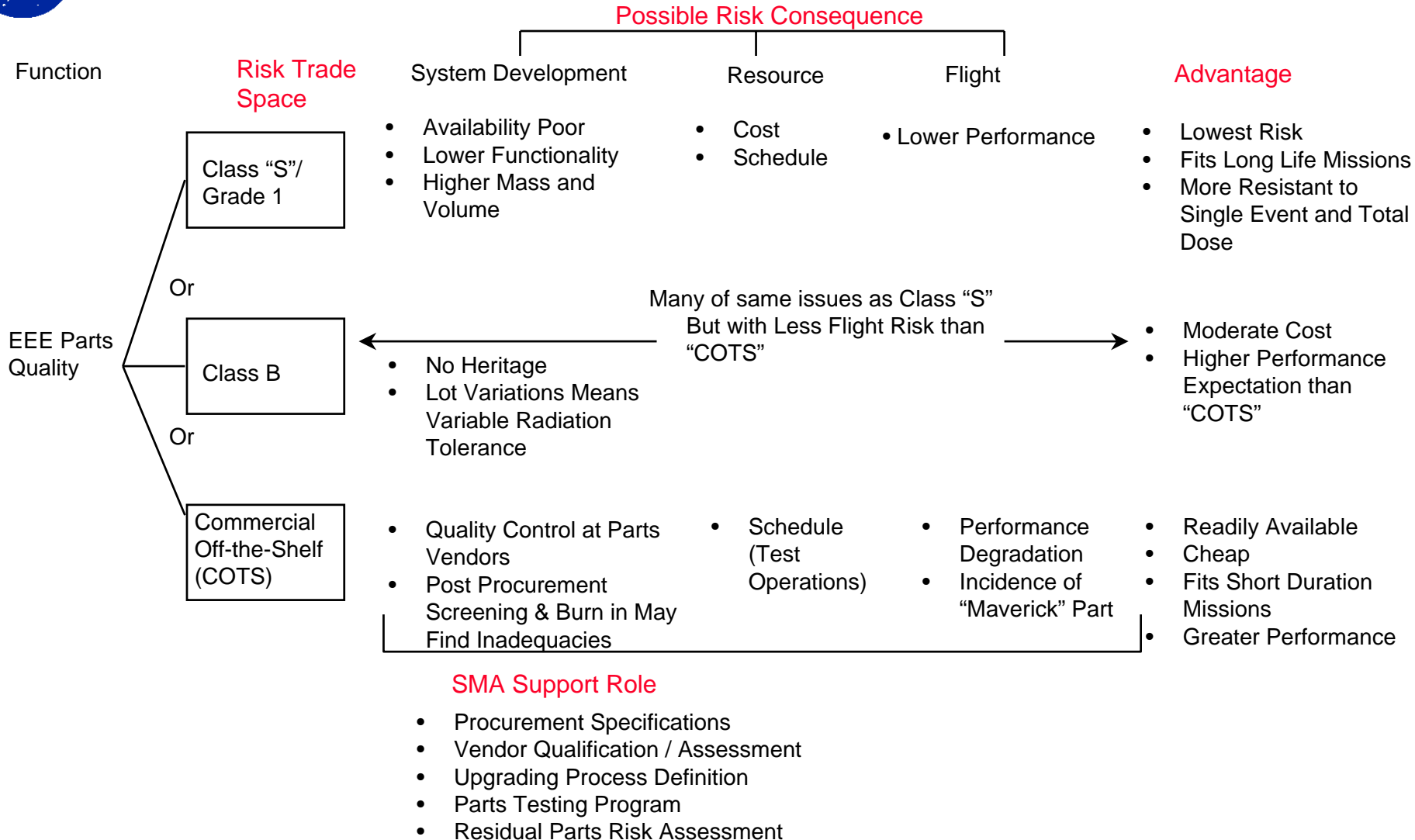
The Goal is to Optimize Overall Risk Posture through Accepting Risk in One Area to Benefit Another. A Strategy to Recover From the Occurrence of the Adverse Consequences Must Also Be Considered.



Risk as a Resource - Redundancy or Single String

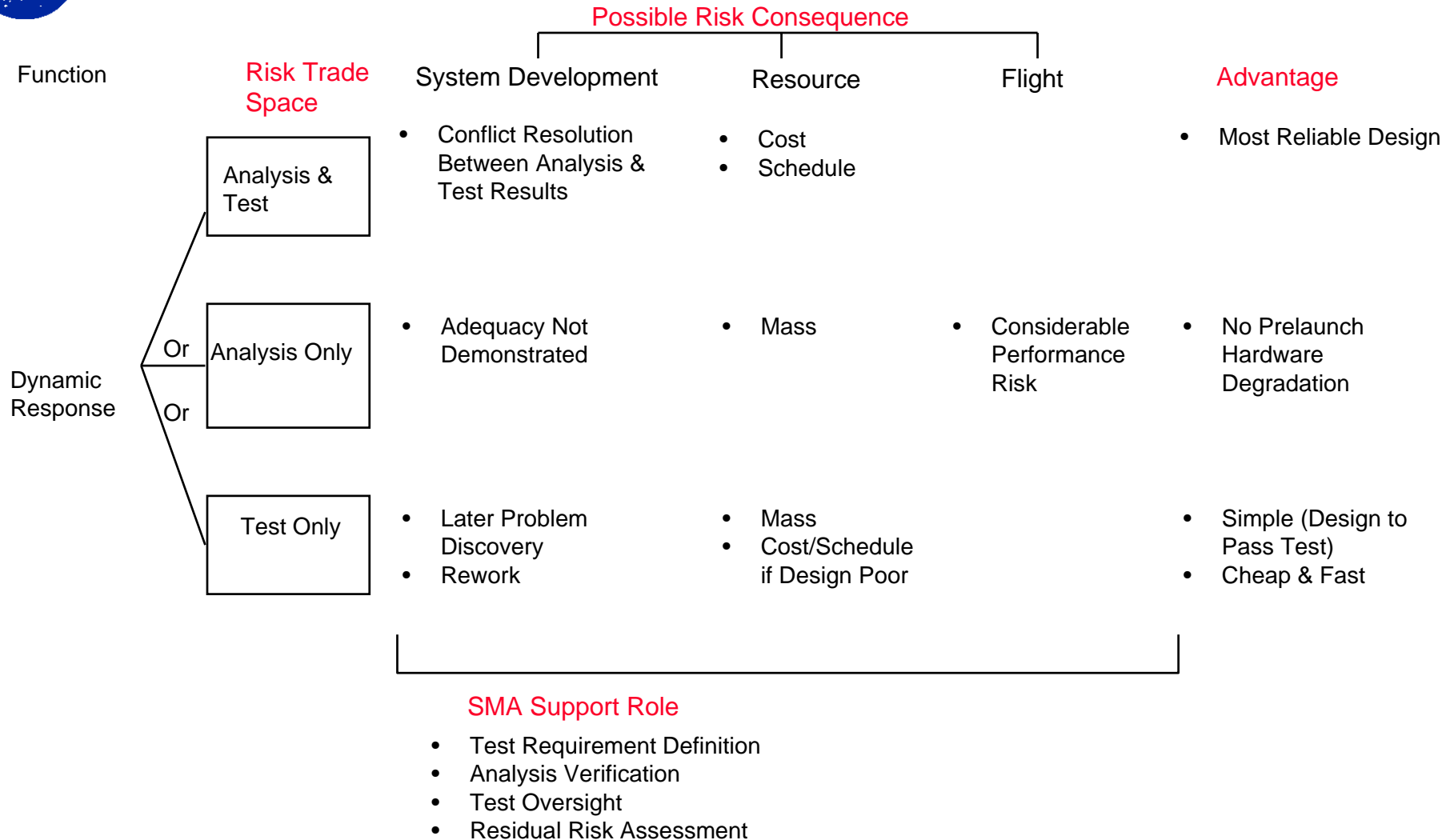


Risk as a Resource - Class of EEE Parts

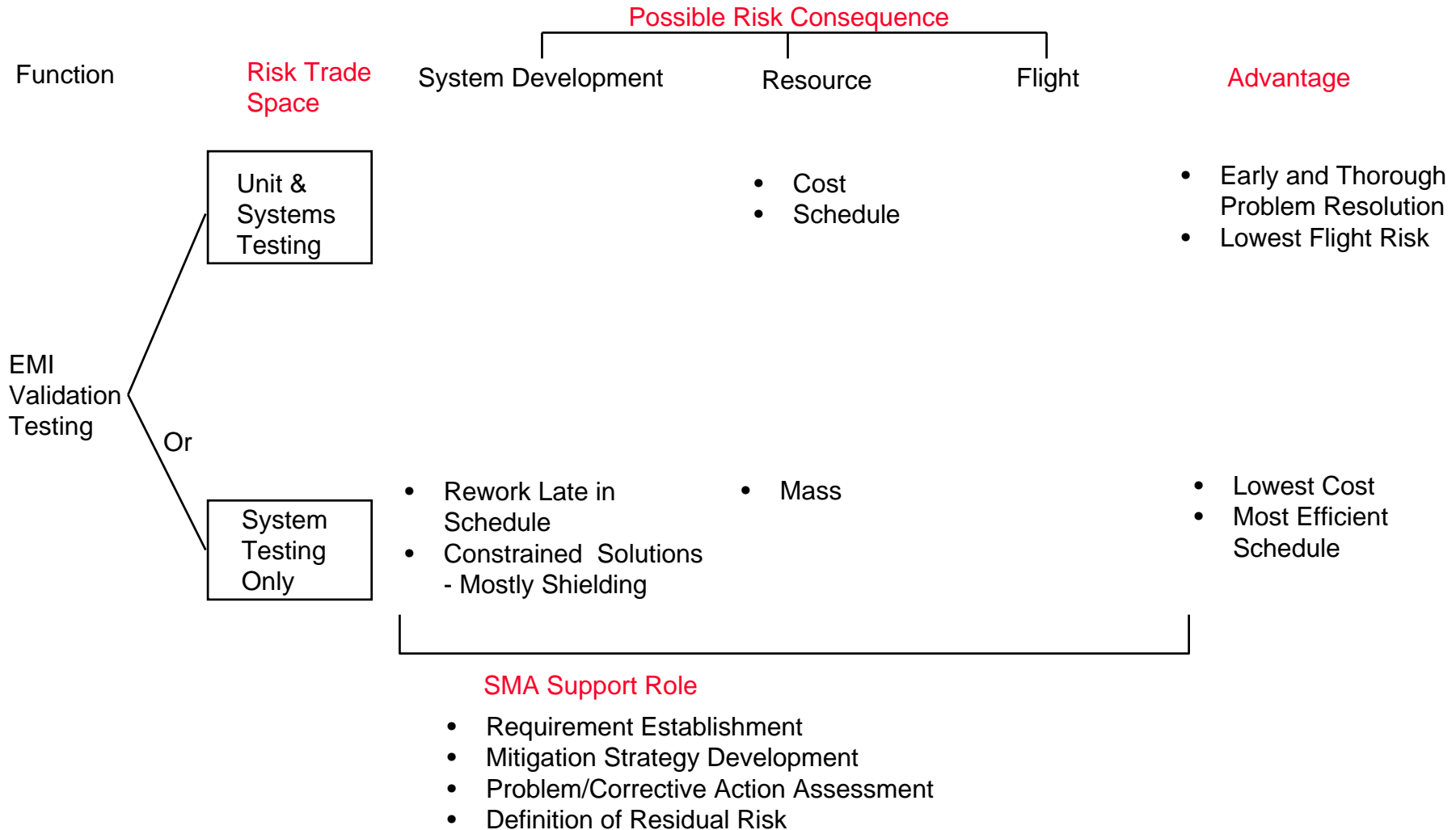




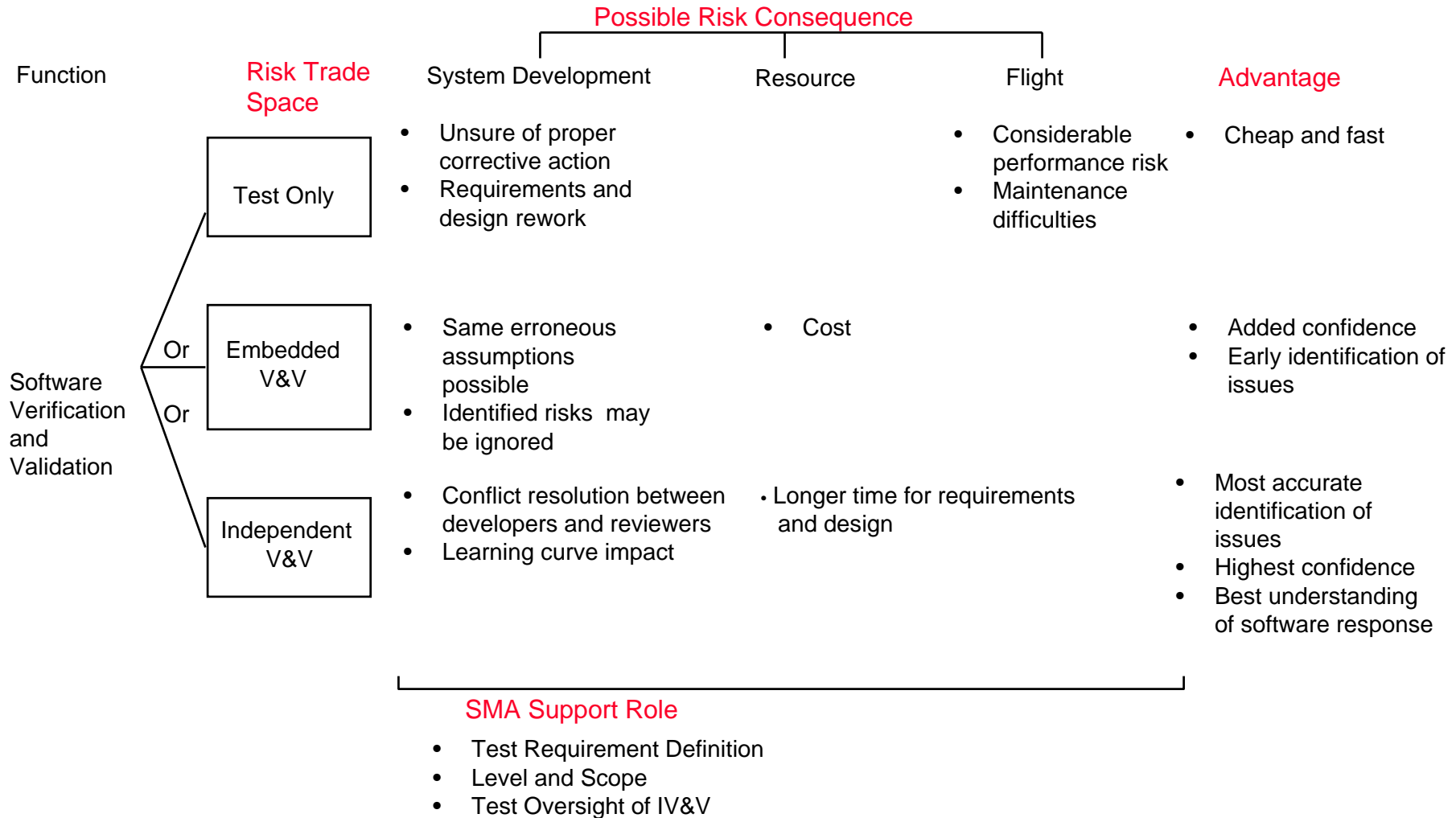
Risk as a Resource - Design Validation



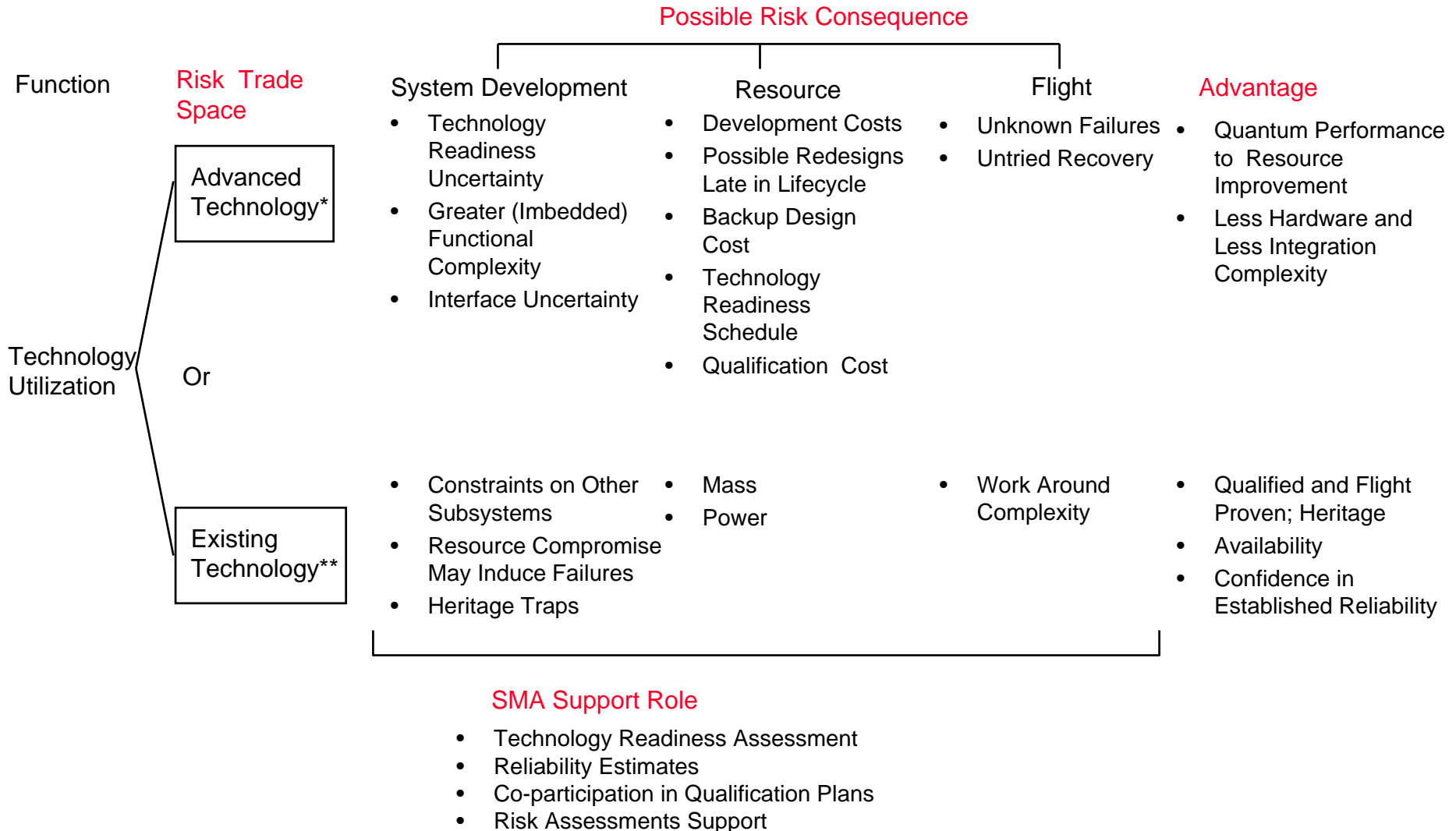
Risk as a Resource - Component Level Validation (e.g., EMI)



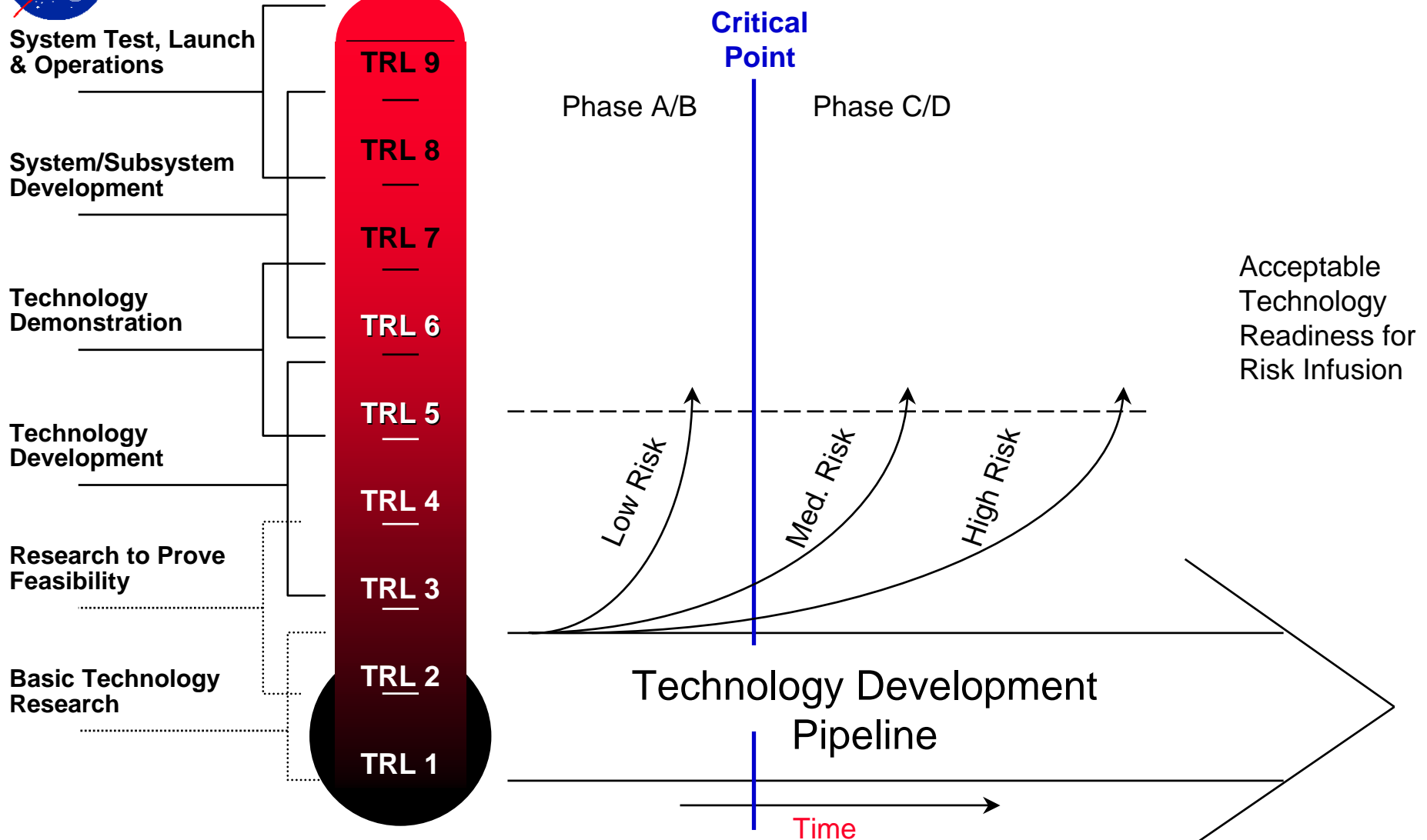
Risk as a Resource - Software Verification & Validation



Risk as a Resource - Technology Utilization

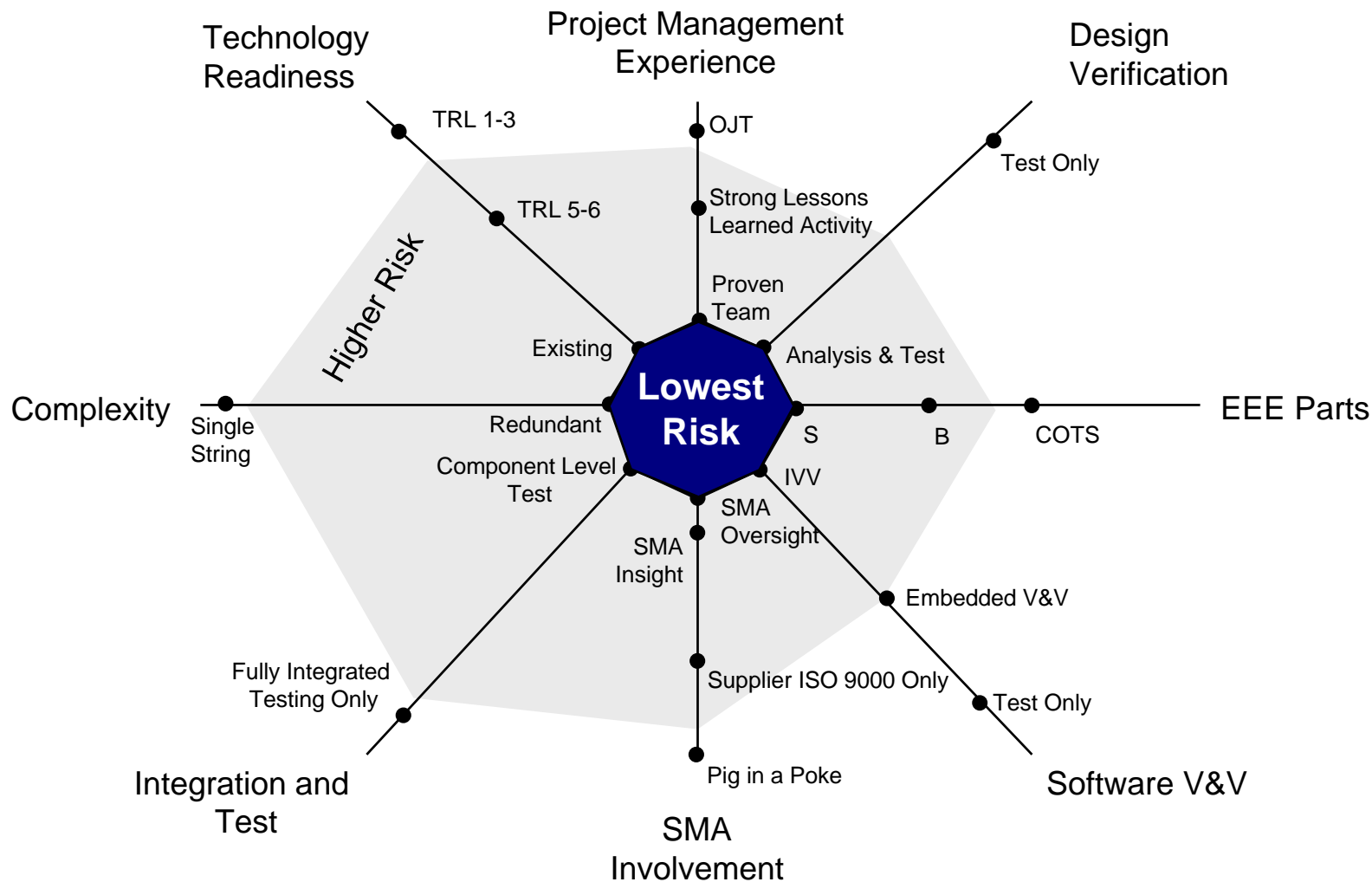


Technology Infusion Risk





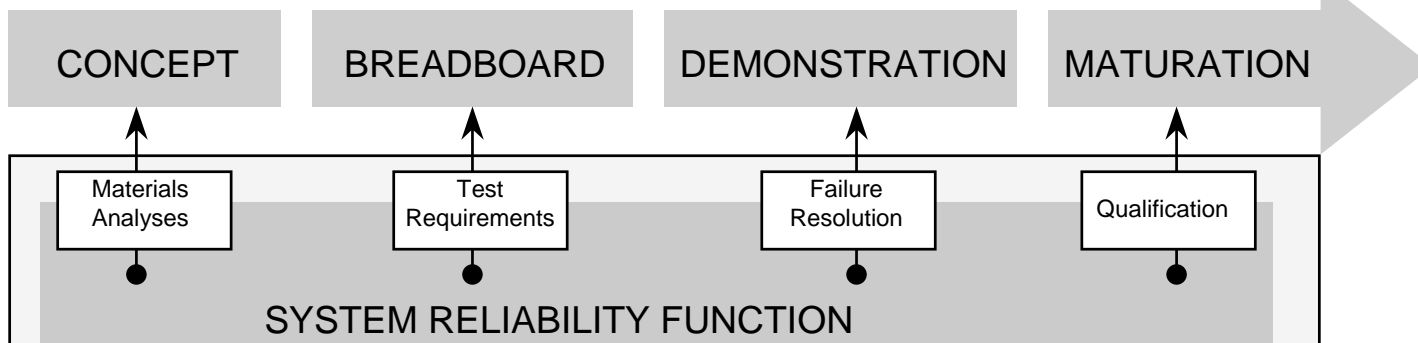
Risk Surface (Notional)



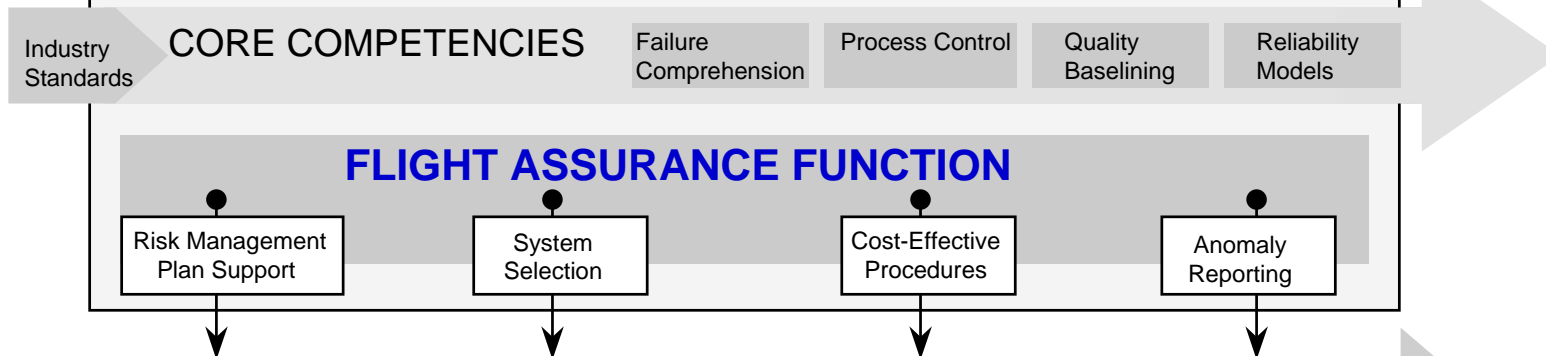


Product Assurance Role Across Life Cycle

TECHNOLOGY DEVELOPMENT



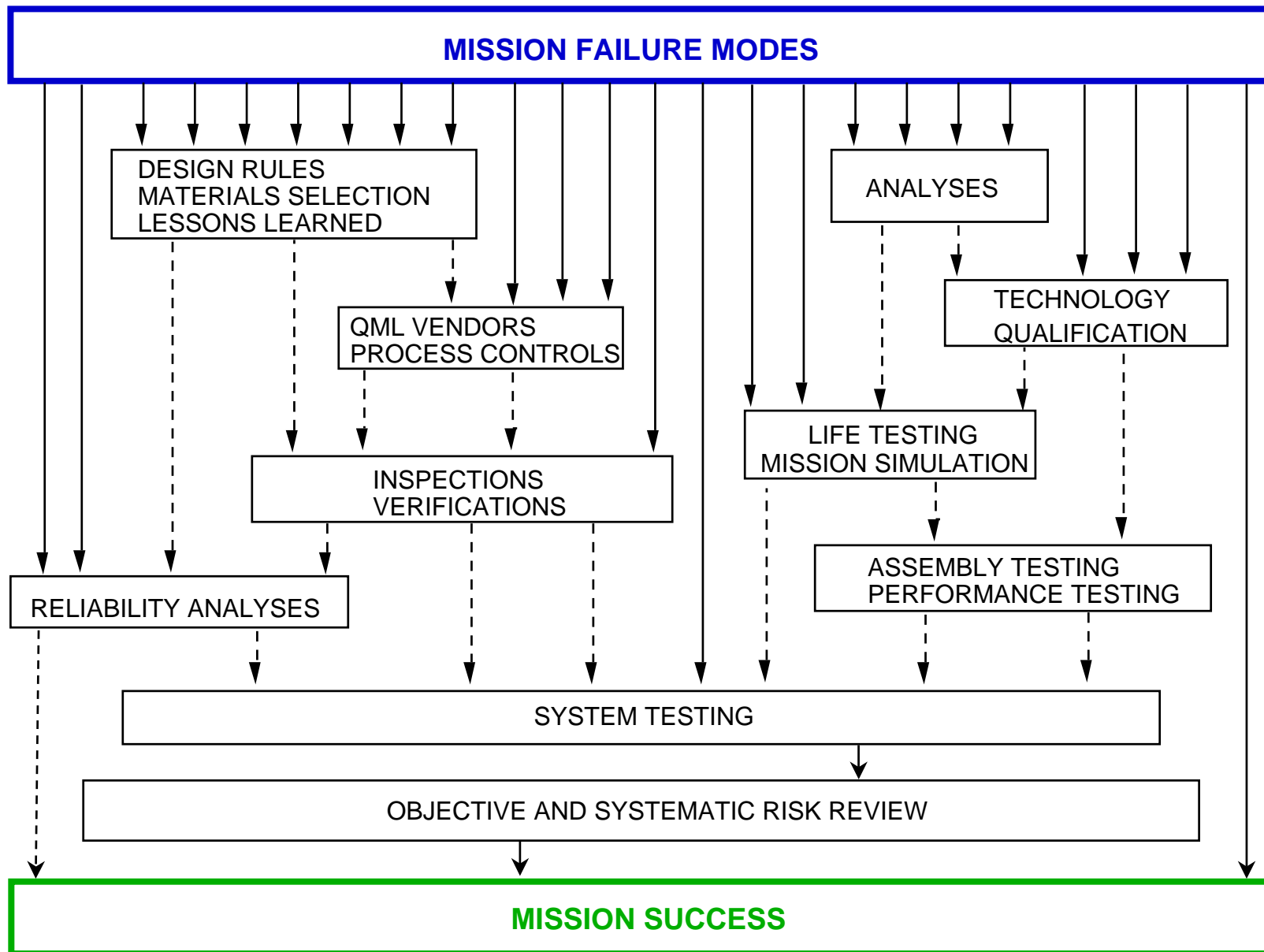
PRODUCT ASSURANCE



SPACECRAFT DEVELOPMENT

RAND

Critical Technology Institute





CALVIN & HOBBS

BILL WATTERSON





Summary

- A structured risk management approach is critical to a successful project
- One size does not fit all; It is tailorable to risk acceptance willingness
- Risk may also be managed as a resource to reach optimal posture
- Elements of good project management are obvious but we still seem to make mistakes, failing to see the consequence of our decisions
- S&MA community can provide valuable support as risk identification, analysis, and mitigation consultants